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XIV.—THE BRITISH SPECIES OF MELANCONIUM.

W. B. Grove.

The species of *Melanconium*, like many others of the commoner *Coelomycetes*,* have been much confused by authors and collectors. In the absence of authentic specimens (usually few in number) and of spore-measurements (which were rarely or never given by the earlier mycologists), there is nothing in these minute fungi to rely upon but spore-form or general outward appearance, which without the help of plates can only be conveyed correctly by a careful choice of words. Hence the enormous confusion, and in the genus *Melanconium* this has been perpetuated and as it were stereotyped by a few unfortunate errors in Saccardo's Sylloge.

The following account of the British species will show that they can be arranged in three distinct sections:—

§ 1. **Melanconium** (sens. strict.), with smoky-brown or blackish spores, exuding as tendril-like masses.

§ 2. **Lamproconium,** with bright coloured spores (in this case, blue).

§ 3. **Ectoconium,** with olivaceous spores, which form in the end a pulverulent shapeless dispersed mass.

The spores in the pustules of the first section are more or less embedded in mucilage and usually therefore, when soaked with moisture, exude through the orifice above the pustule in the shape of long strings or tendrils, which when beaten down by the rain assume the form of a thin black layer closely adherent to the exterior of the bark around the orifice.

In the third section, owing to the want of this mucilage, the spores on their escape become scattered over the matrix as an

* See *Kew Bulletin*, 1917, p. 51.

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irregular effused powdery stratum, which does not in any way adhere to the surface. This powderiness, as will be seen, has led to serious misconceptions.

§ 1. MELANCONIUM.

1. **Melanconium bicolor,** *Nees*, System, 1817, p. 32, tab. 2, f. 27, and

2. **Melanconium betulinum,** *Schmidt & Kunze*, Exsicc. no. 208, 1819.

Perhaps the most far-reaching mistakes have been made in regard to the *Melanconia* on Birch. The differences between *M. bicolor*, Nees and *M. betulinum*, Schmidt et Kunze, as stated in the Sylloge, vol. iii, pp. 755-6, are, it is true, nearly correct. The descriptions of the two species are given by Link, in Linnaeus' Species Plantarum, 1825, ed. iv, vol. 6, pt. 2, from which it appears that for him the only tangible distinction was that the spores of the latter seemed to be 1-septate: for this reason he placed them in different genera.

The starting point of the investigation must lie in *M. bicolor*. The essential points described by Nees (l.c.) are that the fungus occurred in Oak, and that the spores were "eyförmig." He figures them as distinctly ovoid, but on the whole not much longer than broad. Link (l.c. p. 92) does not make the matter clearer; he describes the spores as "subglobosis oblongisque," and the habitat as "in ramis dejectis variarum arborum"; but luckily he adds the synonym "*M. discolor*, Schmidt et Kunze exs. n. 157" (published in 1817). An examination of this exsiccatum shows that the spores tend to be distinctly obovoid (rarely subglobose or oblong), not opaque, with one guttule, and measuring on the average 10-12 × 6-8 μ. This agrees with the fungus called below no. 1.

The other fungus, which seemed to Link to be uniseptate, is called by him (l.c. p. 94) *Didymosporium elevatum*, Link; he cites as its type "*Melanconium betulinum*, Schmidt et Kunze exsicc. n. 208" (published in 1819), and gives the habitat as "corticibus Betularum et Fagorum emortuis." An examination of this exsiccatum shows that the spores are narrowly almond-shaped, rather pointed at the lower end, somewhat granular within, with thicker walls than in no. 1, and therefore somewhat opaque. They measure up to 17 μ long, but the mature forms average about 13-16 by 5-6 μ; they vary also towards being obovoid and subpyriform or even oblong, but present usually a very different appearance from those figured by Nees. This is the fungus called below no. 2.

On investigation of the specimens issued by various mycologists during the succeeding years, they are found to be curiously mixed, but the two types mentioned occur again and again under different names: a list of some of them is given below. It is plain that no. 1 is the true *M. bicolor*, Nees, and no. 2 is the true *M. betulinum*, Schmidt et Kunze. By the initials "*v. v.*" which he appends to each, it is seen that Link was fully acquainted with both. It may be asked then, why he thought

that *M. betulinum* was 1-septate and *M. bicolor* not so: the answer lies in a peculiarity of the contents of the spores. In *M. bicolor* there is, in the majority of cases, a clear central oil-guttule, which may, however, sometimes lie towards either end, or may, though rarely, be divided into two or even three smaller ones. In *M. betulinum* there is seldom such a clear single central guttule, but more often two vacuolar spaces, which approach one another in the middle, and one of which may contain an oil-drop with a square outline towards the centre of the spore. In many, but by no means all of them, there is therefore, under a low power such as Link used, a distinct simulation of a median septum. This appearance vanishes altogether under a higher power, but has misled several observers, Greville, Vestergren, etc.

As regards outward aspect, there seems to be a decided tendency in *M. bicolor* to burst out through a roundish opening, and in *M. betulinum* through an elongated lanceolate fissure. But on a wider examination of many specimens this rule is seen to be subject to so many exceptions that it is impossible to name the two species by external appearance only. In fact they may not be really distinct, but as Tulasne thought two extreme forms of one species. Personally I incline more and more to this view of them as the end terms of a lengthy series, but in the majority of cases the spores appear as if perfectly distinct, and many thousands of species accepted at the present day, both in fungi and in other groups, rest upon no better foundation.

The following exsiccata, among others, have been examined:—

No. 1. **M. bicolor,** *Nees* (spores 10-12 × 6-8 μ).

"*M. discolor*," Holl. Schm. et Kunz. no. 157!
"*M. betulinum*," Desm. Crypt. Fr. no. 135!
" " Moug. et Nestl. Stirp. Crypt. no. 670!
" " Westd. Herb. Crypt. Belg. no. 132!
" " Ellis, N. Amer. Fung. no. 960!
"*M. bicolor*," Ell. et Ev., N. Amer. Fung. ser. ii. no. 2390! (the same as no. 960, and sent out as a correction of the mistake).

No. 2. **M. betulinum,** *Schmidt & Kunze* (spores 13-16 × 5-6 μ).

"*M. betulinum*," Schm. et Kunz. exs. no. 208!
" " Fckl. Fung. Rhen. no. 85!
" " Tranz. et Serebr. Mycoth. Ross. no. 293!
" " Rabenh. Herb. Mycol. ed. no. 590! (marked "= *M. effusum* L. R." in Rabenhorst's writing).
"*M. bicolor*," Roum. Fung. Sel. exs. no. 77!
" " Fckl. Fung. Rhen. no. 84!
" " Syd. Mycoth. Germ. no. 143!
" " Herb. Gerard, "Poughkeepsie, N.Y."!
" " Herb. Berk. "Thorney, Cambs."!
" " Herb. Curtis, "Weybridge, 1856"!
"*Didymosporium elevatum*," Lib. Crypt. Ard. no. 391! p.p.
" " Herb. Hook., Purt. no. 1090!
" *betulinum*, " " " no. 15!

There remains to be mentioned *M. elevatum*, Cord. (Ic. iii. tab. iv. f. 60), which according to his own showing (l.c. p. 22) was on Birch and, as he expressly states, is identical with *M. betulinum*, Schmidt et Kunze. Saccardo wrongly transfers this to Oak (Syll. iii. 753), and combines it with an English specimen on Oak from Langridge, which was named by Cooke (Grevill. xiv. 126) *M. elevatum*, but which turns out on examination to be *Dichomera Saubinetii*. *M. elevatum*, Corda, therefore entirely disappears.

The same may be said of *Didymosporium profusum*, Fr. Syst. Myc. iii. 487 = *Stilbospora profusa*, Grev. Scot. Crypt. Fl. tab. 212, f. 1 (1826). Original specimens in Herb. Kew, with the name written in Greville's own hand, are on Birch and are identical with *M. bicolor*, Nees, though he certainly included under the name several of the other species. The supposed reidentification by the writer of Greville's species in Journ. Bot. 1886, p. 197, turns out to be an error; at that time there was no opportunity of examining Greville's specimens, and his figure is decidedly misleading. The peculiar shape and position of the single guttule gives under a low power, in spores taken from the original specimens mentioned above, a very deceptive simulation of a median septum. The same misconception no doubt accounts for some of the other species placed under *Didymosporium*.

3. **Melanconium zonatum**, *Ell. & Ev.* in Peck, 44th Rep. New York State Mus., 1890, p. 136.

This fungus, described on *Ostrya virginica* from Iowa, U.S.A., is represented in Herb. Kew by a specimen issued by Ellis, North American Fungi no. 961! named "*M. bicolor*," a name which was afterwards corrected by the authors themselves, who issued the true *M. bicolor* in Ser. ii., no. 2390, and then altered the name of no. 961 to *M. zonatum*.

Hitherto this species has not been considered British, but there is a specimen in Herb. Berk. no. 1574 (apparently British, though no locality is given) on Birch, misnamed "on Beech." The spores of this differ from *M. bicolor* exactly in the characters assigned to *M. zonatum*, and it is no doubt that species. *Ostrya* and *Betula* are closely allied genera.

The following is the description of the British specimen:—

Pustules scattered, black, round, about 1 mm. diam., slightly elevated and erumpent in a depressed-conical fashion, the whitish stroma hardly ever showing. Spores obovoid, or oblong and then faintly curved in profile, rounded above, somewhat pointed at times below, dusky-brown, 10-12 × 7-8 μ, marked across the middle by a paler semipellucid zone which in profile is seen to be caused by a large vacuolar space (not oil guttule).

On bark of Birch (Herb. Berk. no. 1574!), mixed with *Libertella betulina*.

The type-specimen on *Ostrya* differs only in having more distinctly oblong or subcylindrical spores, measuring 13-15 × 6-7 μ; the spores have the same dusky colour, which is different from that of *M. bicolor*, and the same median zone, due to the same cause. The whitish stroma is not really wanting, as Ellis

and Everhart allege; a horizontal section of their own specimens will show it, but it does not protrude through the spore-mass and make a white "eye" so often as happens in *M. bicolor*. The British specimens are practically intermediate between *M. zonatum* and the typical *M. bicolor*, of which the former might well be considered to be only a strongly marked variety.

4. **Melanconium stromaticum,** *Corda*, Ic. Fung. i. 3 (1837); Sacc. Syll. iii. p. 750.

This species presents the usual source of confusion, in that it was considered by the earlier authors to include what we should now call several species. But there is one certain guide available: Corda, in Sturm's Deutschland's Flora, states definitely that one of the original specimens was discovered near Friedland in 1830 on *Carpinus*, though he also included forms on *Fagus*, on *Juglans*, and on fruit-trees. To this Saccardo has added greater confusion, by a misconception of Corda's words in the *Icones*, i. 2, concerning his variety *ramulorum*. Corda expressly states that it occurs "in ramulis, ubique," meaning as the context unmistakably shows "in ramulis *Betulae albae*." What Corda was thinking of is evidently that form of *M. bicolor* which does, as a matter of fact, occur everywhere upon the smaller branchlets of Birch. Saccardo, not perceiving this, applies the name *M. bicolor*, var. *ramulorum*, to a *Melanconium* on *Carpinus*, being misled by what Fuckel had previously done (Symb. Myc. p. 188).

On examining the published exsiccata, one finds that specimens identical in all respects have been issued under the names *M. stromaticum* and *M. ramulorum*. It will be better, therefore, to retain the former name for this species on *Carpinus*, which is seen even with the naked eye to be different from others, and agrees fairly well with Corda's figure in Sturm except that it does not have so large a stroma.

The following exsiccata have been examined:—

"*M. stromaticum*,"	Fckl. Fung. Rhen. no. 90!
,, ,,	Rabenh. Fung. Eur. no. 1290!
,, ,,	Oud. Fung. Neerl. exs. no. 294!
"*M. ramulorum*,"	Roum. Fung. Gall. exs. no. 1432!
,, ,,	Thüm. Mycoth. Univ. no. 1882!

Fuckel's no. 90 and Roumeguère's no. 1432, though gathered far apart in space and time, look as if they might have formed part of the same gathering. A description of this species is appended.

Pustules scattered, 0·5-1·5 mm. diam., covered by the bark, circular, very depressed, sometimes almost flat, but dehiscing in the centre by a round protruding pore, black, showing through the periderm, seated on a small pallid olivaceous stroma, always much less conical than in *M. bicolor* and usually without any white "eye." Spores obovoid, olivaceous-brown, usually with one or two guttules, resembling those of *M. bicolor*, 9-15 × 7-8 μ, often with a pale apiculus at the base, becoming at length effused round the pore as a black stain.

On dry dead twigs and branches of *Carpinus Betulus*, but I have found it once on still living twigs.

The synonymy is as follows:—

Dapsilosporium stromaticum, Corda, in Sturm, Deutsch. Flor. iii. 75, f. 38 (1837).

Melanconium ramulorum, Sacc. Syll. iii. 754.

M. bicolor, var. *ramulorum*, Sacc. Fung. Ital. t. 1978 (*non* Corda).

5. **Melanconium apiocarpum**, *Link*, Sp. Pl. ii, p. 90; Sacc. Syll. iii, p. 755.

This species is that which is also called by Saccardo *M. sphaeroideum*. The following exsiccata were examined:—

"*M. apiocarpum*," Fckl. Fung. Rhen. no. 89!
" " Rabenh. Fung. Eur. no. 469!
" " Herb. Winter, legit Auerswald!
"*M. sphaeroideum*," Roum. Fung. Gall. exs. no. 933!
" " Cooke, Fung. Brit. exs. no. 624!
" " Vize, Microfung. Brit. no. 114!
" " Syd. Mycoth. March. no. 1864!
"*M. elevatum*, f. *Alni*, Rabenh. Fung. Eur. no. 1288!

All these are on *Alnus* and they are all the same. The spores in every case are oval, ovoid or oblong, sub-pyriform or (very rarely) roundish, averaging 10-13 × 6 μ, with one or two guttules, smoky-brown, semipellucid, agreeing exactly with Corda's figures of *M. apiocarpum*, and of about the size he gives, viz.: ·000473 = 13 μ. They agree also with Saccardo's figure of *M. sphaeroideum* (tab. 1079). Corda shows clearly, and Saccardo indistinctly, the arrangement of the guttules which led to the false idea, prevalent among mycologists in the past, that *M. apiocarpum* has 1-septate spores.

M. didymoideum, Vestergr. is an extreme form of the same species. The author was misled into thinking that the fungus usually called *M. sphaeroideum* on *Alnus* had round or oval spores with one guttule in the middle; consequently, he thought that his fungus with twin guttules must be something different. This is not so, as is easily seen on examining any of the above-mentioned exsiccata.

It must be considered then that all the specimens on Alder examined belong to *M. apiocarpum*, Link, and that the true *M. sphaeroideum*, Link is another species. It will be seen that Link, in his description of the latter (Sp. Pl. p. 92), calls the spores "globosis," and says that they exactly agree with those of *M. sphaerospermum*. This statement could not possibly be made of the fungus on Alder. Moreover, he quotes as the type "*Stilbospora microsperma*, Nestl. exs. n. 384," but had only seen dried specimens. On examination this type is seen (in the Herb. Kew example) to be on *Rhamnus Frangula*, and to have mostly roundish or ovoid spores, measuring about 8-9 × 5-6 μ (occasionally 10 μ long), and really presenting, under a low power, a certain resemblance in gross to *M. sphaerospermum*. These and other specimens on *R. Frangula* also bear a close external resemblance to Link's diagnosis, and no doubt represent the fungus he had in mind. But as usual the names have been used con-

fusedly. Fuckel places under *M. microspermum* what is clearly *M. Hedrerae* (Fung. Rhen. no. 2106!), and Desmazières places under *M. sphaeroideum* several species, including, however, among them *M. apiocarpum* on *Alnus*.

It will clear up this confusion if it is agreed to consider *M. apiocarpum* as belonging typically to *Alnus*, and *M. sphaeroi-* to *Rhamnus*. Whether the two are really distinct is another question which cannot yet be answered. Link obviously considered them to be so, but as he quotes no type for *M. apiocarpum*, it must ever remain uncertain what he meant by this name, for he compares it only with *M. ovatum* (l.c. p. 89), of which he says it may be a variety with smaller and less pellucid spores. This indication, so far as it goes, is perfectly consistent with the identification here advocated.

The description and synonymy will then be as follows:—

Pustules scattered, about 1 mm. in diameter, conical, rather prominent, very black, with a central white stroma. Spores oblong or ovoid, obtuse at both ends, especially above, with one or two guttules, smoky-brown, semi-pellucid, 10-13 × 5-6 μ, appearing often falsely 1-septate and didymous, *i.e.*, subconstricted at the middle.

On twigs of *Alnus*. Not uncommon; specimens found by the late Dr. J. W. Ellis at Bridgnorth are exactly *M. didymoideum*.

Syn.—*M. sphaeroideum*, Sacc. Syll. iii. 755 (*non* Link); Fung. Ital. tab. 1079.

M. didymoideum, Vestergr. in Hedwig. 1903, xlii. 82.

No British specimens of the fungus on *Rhamnus* (*M. sphaeroideum*) have so far been seen. It will be noted that Saccardo appears to found his reference of *M. sphaeroideum* to *Alnus* on the quotation of that name by Mougeot as a synonym of his *Stilbospora microsperma*; Fuckel had expressed the same idea previously.

All the foregoing species are closely similar; the next group is distinguished by possessing much larger spores. It may be divided into three forms, which occur on Hornbeam, Walnut, and Beech respectively. The two first are said to be very similar: all of them may perhaps wander to other hosts.

6. **Melanconium magnum**, *Berk.*, Outl. p. 324 (1860); Sacc. Syll. iii. 753.

Naemaspora magna, Grev. Scot. Crypt. Flor. tab. 349 (1823).

Stilbospora magna, Berk. Eng. Flor. v. 357 (1836).

Subspecies 1. **M. carpineum**, comb. nov.

Sphaeria carpina * (? misprint for *carpinea*) Sow. Fung. tab. 376 (1803). *Naemaspora carpinea*, Baxt. no. 76.

Spores ovoid or oblong, thick-walled, dark greyish-brown, 18-25 × 10-11 μ.

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* Not *Carpini*, as usually quoted.

On dead trunks of *Carpinus Betulus*.

This is what is generally held to be the case, but personally, I have found that all the specimens on *Carpinus* attributed to *M. magnum* are either *M. stromaticum* or other perfectly distinct fungi such as *Stilbospora angustata*, Pers.

Subspecies 2. **Melanconium juglandinum**, *Kunze*, in Ficinus, Flor. Dresd. ed. II, ii. 260 (1823). Sacc. Syll. iii. 753; Fung. Ital. tab. 1081.

M. Juglandis, Corda, Ic. Fung. iii. 21, f. 58, and *forma diffusa*, f. 59 (1839).

Spores as above, usually 18-20 × 12-14 μ, but reaching even to 25 × 15 μ.

On branches and trunks of *Juglans*, sometimes attacking and killing the branches of old, but living, walnut trees; its large black tendrils sometimes cover a whole trunk.

There are also in Herb. Berk., from U.S.A., several closely allied forms—one on *Juglans regia*, with more ellipsoid and less opaque spores (*Ellis*, New Jersey, no. 2580! and N. Amer. Fung. no. 120!); a similar form on Hickory, with very opaque spores (*Ellis*, New Jersey, no. 2581!); and an effused form on *Acer*, like Corda's figure of *f. diffusa*, but with still larger spores, 30-35 17-18 μ (*Wright*, Connecticut, nos. 5615, 5646!; *Ellis*, Potsdam, N.Y., no. 1900!). Here, as in the other cases, the effused form is merely the result of exposure to the weather.

This species, no. 6, being already well-known as British, needs no further description, but the case is different with the next.

7. **Melanconium ovatum**, *Link*, Sp. Pl. ii. 89 (1825). Sacc. Syll. iii. 758.

Stilbospora ovata, Pers. Obs. Mycol. i. 31, tab. 2, f. 2 ("*in truncis fagineis*"); Syn. p. 96. Grev. Scot. Crypt. Flor. tab. 212, f. 2, *p.p.*; *non* Berk. Engl. Fl. v. 357.

This species has been much confused, and made to include, not only *M. juglandinum*, but *Steganosporium pyiforme*, and even *M. bicolor*, etc. But Persoon says (Obs. p. 31) "in truncis fagineis, formam ovatam exacte repraesentat . . . . septula distincta non observantur," and he shows by his figure (t. 2, f. 2) that the spores were unmistakably pyriform. He quotes, in Syn. Fung. i. 96, *S. pyriformis*, Hoffm., which is seen, however, on referring to Hoffmann, Deutsch. Flor. tab. 13, f. 2, to be another fungus.

Link, who quotes *Stilbospora ovato*, Pers. as the type of *M. ovatum*, says (pp. 89-90) "acervis sporidiorum elevatis irregulariter effusis, sporidiis maximis compactis ovalibus et pyriformibus atris pellucidis." He adds that *Stilbospora ovata*, Schmidt et Kunze n. 35, and *S. Juglandis*, Fr. Exs. n. 215 "statum primitivum sistunt," but these references are now of little value.

No doubt Link's idea was an inclusive one, but the British specimen on Beech accords exactly with his description, and is not like the other large-spored species. The name *M. ovatum* should therefore be restricted to this fungus.

The description is as follows:—

Pustules scattered, covered, flatly conical, 1-2 mm. across, then erumpent by a slit, black. Spores large, oval, but more or less attenuated at the base, *i.e.*, pyriform, translucent-black, 20-25 × 10-12 μ, agglutinated in heaps which are at first convex, then effused; sporophores long, branched.

On bark of *Fagus*, Batheaston! (*Broome*). This species is distinguished from *M. magnum* by the fact that many of the spores are decidedly pyriform, although they vary as usual towards ovoid-oblong; whenever *M. ovatum* has been recorded on *Juglans*, possibly *M. juglandinum* has been really present.

There remain now for consideration two species which have much smaller spores. The first of these has again been the subject of much confusion.

8. **Melanconium Hederae,** *Preuss*, Pilz. Hoyersw. no. 312, in Linnaea, 1855, xxvi. 717; Sacc. Syll. iii. 751.

Coniothyrium Hederae, Sacc. Mich i. 204; Syll. iii. 307.

Phoma Hederae, Desm. Pl. Crypt. no. 350.

Melanconium microspermum, Nees, Syst. Pilz. p. 32, 1817 (*quoad in Hederae*). Fckl. Fung. Rhen. no. 2106!

Stilbospora microsperma, "Pers." Auct. p.p.

The matter has here been much complicated by the fact that the issuers of exsiccata have, without knowing it, included two perfectly distinct fungi on small branches of Ivy under the same name:—one with a definite membranous pycnidium, which constitutes *Coniothyrium olivaceum*, Bon. f. *Hederae*, Sacc. (Syll. iii. 306), and the other with a thick proliferous stratum, which may sometimes extend all round the spore-containing cavity (not below only), and which bears *Melanconium*, not *Coniothyrium*, spores. The first is seen in Fckl. Fung. Rhen. no. 93!, the second *ibid.* no. 2106!

The following exsiccata have also been examined:—

"*Phoma Hederae*," Desm. Pl. Crypt. no. 350!
,, ,, Moug. et Nestl. Stirp. Crypt. no. 979!
,, ,, Berk. Brit. Fung. no. 90!
,, ,, Herb. Berk. "King's Cliffe"!
,, ,, Herb. Berk. "Norths."!
,, ,, Herb. Cooke, "Shere" (Dr. Capron), on leaves!

All these are *M. Hederae*. Dr. Capron's specimens, on ivy leaves, have a thick proliferous stratum like that at the base of a *Phomopsis*, the spores are on linear sporophores longer than themselves, and are at first colourless, small and round, afterwards becoming ovoid, brownish, 7-9 × 3-5 μ, and uniguttulate. But Fuckel's specimen, no. 93! ("*Coniothyrium olivaceum*, Bon., ad *Hederae* ramos aridos"), has a thin subglobose translucent membranous pycnidium, about 200 μ diam.; spores 4-5 × 2-3 μ, without visible sporophores. *Coniothyrium Hederae*, Sacc.

Mycoth. Ven. no. 1523!, on leaves of ivy, has similar pycnidia; but no spores could be found.

The description of the species is as follows:—

Pustules scattered, oblong or oval, 300-1000 μ long, seated in the outer cortex, covered by the blackened epidermis, somewhat prominent, black, opening by a pore or slit which afterwards becomes widely torn. Spores oval or obovoid, at first colourless, then brownish or olivaceous-black, usually 1-guttulate, 6-8 × 3-5 μ; sporophores linear, obtuse, colourless, irregular or flexuous, 15-18 × 1·5-2·5 μ.

On small dry dead stems of *Hedera Helix*, or rarely on the leaves. Common everywhere, if looked for.

Sometimes under a low magnification the black mass of spores exactly simulates an ostiolate pycnidium; on the leaves it is smaller and rounder, and more like a *Coniothyrium*, but still without a true pycnidium, only a proliferous stratum.

9. **Melanconium Pandani,** *Lév.* in Ann. Sci. Nat. 1845, iii. 66; Sacc. Syll. iii. 759; Fung. Ital. tab. 1077.

Pustules large, embedded in the bark, compound, tubercular, erumpent, black, rather thick, prominent, 1-3 mm. diam. or even more, often grouped in lines. Spores oblong-ellipsoid or somewhat ovoid, singly very pale-olive, dark-olive in mass, 5-9 × 3-4 μ, often slightly curved in profile, with one or two very minute guttules, involved in mucilage, oozing out in the form of tendrils which ultimately blacken the surface of the bark; sporophores very long, colourless, flexuose, branched.

On living bark of cultivated *Pandanus*, in Botanic Gardens, Kew, Dublin, etc. It is recorded on the Continent on the leaves also; it causes a disease which, if neglected, spreads rapidly, and soon kills the plants.

§ 2. LAMPROCONIUM.

10. **Melanconium Desmazierii,** *Sacc.* in Mich. ii. 355; Syll. iii. 751; Fung. Ital. tab. 1083.

Discella Desmazierii, B. et Br. Ann. Nat. Hist. 1850, v. 377, tab. 12, f. 8 *a, b, c.*

Discula Desmazierii, Faun. et Flor. Kew, p. 172.

Epidochium Maertensii, Westd. no. 1078.

Pustules crowded, hidden under the bark, round, depressed, occasionally umbonate in the centre, without a pycnidium, not or scarcely erumpent, black, $\frac{1}{2}$-1 mm. broad. Spores fusoid, obtuse at the ends, especially above, with a conspicious thick wall, at first quite colourless, then indigo blue, sometimes 3-guttulate, 30-36 × 6-10 μ; sporophores filiform, sometimes forked, colourless, 30-60 × $1\frac{1}{2}$ μ, rising from a thick brownish cellular stratum.

On living twigs and branches of *Tilia vulgaris, T. platyphyllos,* but more often on dead branches. Said to be a destructive parasite; the situation of this species in *Melanconium* is abnormal, but there seems to be no more suitable position for it than as a section of that genus. The colour of the spores can attain to a deep sea-blue; the pycnidium attributed to it by Berkeley seems to me to be non-existent.

§ 3. ECTOCONIUM.

11. Melanconium sphaerospermum, *Link*, Sp. Pl. ii, 1825, p. 91.

The species of *Melanconium* on the Reed-like Grasses have been misunderstood to an unusual degree. There appear to be at least two rather common forms in Europe, which resemble each other very closely, but differ slightly in the size and shape of their spores.

No. 1. has spores that in face-view appear all but perfectly circular, but when seen in profile exhibit a lens-shaped section which is in general equally biconvex, but sometimes approaches a plano-convex form, with one side flatter than the other, though always with a rather acute or somewhat flattened margin. These spores measure about 9-10 μ in diameter, by about 3-4 μ in thickness; they are dark but clear olivaceous, without guttules or granules. From the sudden change in refractive power due to the flattened margin, the dark centre, when seen in full face-view, appears to be surrounded by a paler semi-translucent zone; when seen in profile, the best-developed spores show this edge as a translucent band passing across the figure from angle to angle. They present in fact a rather close resemblance to the ascospores of *Roesleria* (*see* Ann. Bot. 1916, xxx. 412), and in a smaller degree to those of *Eurotium*.

No. 2. differs in having generally smaller spores, 6-8 μ wide, 2-2·5 μ or even 3 μ in thickness; they are also not so persistently circular, but rather ovate, subelliptic, oblong or irregular in face-view, although in profile they exactly resemble no. 1.

Both these kinds of spores are borne on short straight sporophores, which arise from a proliferous stratum or occasionally from a well-developed stroma. In both the spore-bearing stratum originates beneath the epidermis, and the spore-mass bursts through it in a long slit (or two parallel slits) and becomes effused on the surface of the matrix. The spores are at first more or less compacted like those of other *Melanconia*, but ultimately they break up to form a black pulverulent external stratum which shows no signs of its internal origin.

The apparent thickness of the lens-shaped spore depends naturally upon the angle at which it is seen; all possible widths from 2 or 3 μ up to 8 or 10 μ can often be seen in the same field.

No. 1. is *Melanconium sphaerospermum*, Link, Sp. Pl. ii. 91 (1825) = *Stilbospora sphaerosperma*. Pers. Obs. Mycol. p. 31, pl. 1, f. 6 (1796); Syn. Fung. p. 97 (1801).

No. 2. is *Melanconium Donacis*, Thüm. Contr. Myc. Lusit. no. 190! (Non *Coniosporium Donacis*, Sacc.)

But, strange to say, both these fungi have also been considered by collectors to be Hyphomycetes, of the § Dematiei, which in their advanced effused state they much resemble.

No. 1. is *Coniosporium Arundinis*, Sacc. Mich. ii. 124 (1880); Syll. iv. 243 = *Gymnosporium Arundinis*, Cord. Ic. Fung. ii. 1, tab. 8, f. 1 (1838) = *Papularia Arundinis*, Fr. Summ. Veg. Scand. p. 509 (1846).

No. 2. is *Coniosporium inquinans*, Dur. et Mont. Flor. Alger. Crypt. i. 327 (1849) = *Gymnosporium inquinans**, Berk. Plants Port. Welw. p. 7 (1853) = *Papularia Arundinis*, Sacc. Veg. Ven. Spec. p. 179, pl. 16, f. 49-51 (1873).

The following exsiccata, as well as many others in the Kew Herbarium, were examined and gave unqualified support to these conclusions:—

No. 1. *Stilbospora sphaerosperma*, Holl, Schm. u. Kunz. no. 102!, on culms and sheaths of reeds.

Melanconium sphaerospermum, Moug. et Nestl. Stirp. Crypt. no. 1258!, on *Arundo Phragmites*; Desm. Crypt. Fr. no. 326!, on *Arundo Phragmites* and other *Gramineae*; Herb. Berk. "Tansor. Northts." March, 1839!, on culms of reed.

Coniosporium Arundinis, Rab.-Wint.-Pazsch. Fung. Eur. no. 3996!, on culms of *Phragmites*; Tranz. et Serebr. Mycoth. Ross. no. 145!, on stems of *Phragmites communis*; Ell. et Ev. N. Amer. Fung. no. 2794!, on dead canes of *Arundinaria macrosperma*.

Papularia Arundinis, Herb. Cooke, "Ashmanhaugh," Dec. 1876!, on culms of reed.

No. 2. *Melanconium Donacis*, Moller, no. 97!, "ad culmos emortuos *Arundinis Donacis*," Baleia prope Coimbra, Aug. 1878.

Coniosporium inquinans, Roum. Fung. Sel. Exs. no. 4697!, on culms of *Arundo Donax*; Herb. Kew, Uganda!, on dead elephant grass (*Pennisetum*).

Coniosporium Arundinis, Herb. Kew. "Glasgow" Oct. 1911!, "on bamboo canes."

Gymnosporium inquinans, Berk. Welw. no. 20!, Portugal, on culms of *Arundo Donax*.

Papularia Arundinis, f. *platyspora*, *erumpens*, Sacc. Mycoth. Ven. no. 1072! and f. *microspora*, *superficialis*, ibid. no. 1073!, both on culms of *Arundo Donax*; Fckl. Fung. Rhen. no. 99!, on leaves and sheaths of *Phragmites*.

All the specimens classed under No. 1 have identical spores, and differ merely in age and freshness: the same is true of No. 2., but it is also evident on careful examination that no exact line of demarcation can be drawn between the two forms.

In addition to these, there is a third form, No. 3., more rarely found, it appears, in Britain. It occurs upon bamboo, and has hitherto been usually classed in herbaria as:—

Coniosporium Bambusae, Sacc. Mich. ii. 124 (1880) = *Gymnosporium Bambusae*, Bolle et Thüm. Contr. Fungh. Litor. Austr. in Boll. Soc. Adriat. iii. 432, pl. 1, f. 12 (1877).

This form differs from No. 2, of which it has the spores, only in the smaller and less elongated pustules. On the leaves of bamboo the pustules are always still smaller and rounder than on the culms, and appear more often superficial. It is no doubt the same as:—

* Berkeley's specific name was given independently. From his remarks (l.c.) he evidently was not acquainted with the existence of the earlier name.

Melanconium sphaerospermum, subspecies *Bambusarum*, Penz. et Sacc. in Malpighia, 1901, p. 238.

Conidia smaller than in the type, equally compressed, 6-8 μ diam., 3-4 μ thick, biconvex.

On culms of bamboo, Java. (*n.v.*)

The following exsiccata, among others, have been examined :—

No. 3. *Coniosporium Bambusae*, Roum. Fung. Gall. Exs. no. 936 ! on leaves, and no. 1198 !, on culms of *Bambusa mitis*; ibid. no. 3691 !, on leaves of *B. nigricans*; Sydow, Mycothec. Germ. no. 1197 !, on old culms of bamboo.

Gymnosporium Bambusae, ex Herb. de Thüm., on culms of *Bambusa arundinacea*, Gorizia ! (legit *Bolle*); Thüm. Mycoth. Univ. no. 885 !, on the same; Ell. et Ev. N. Amer. Fung. no. 1628 !, on culms of *Bambusa*; Sacc. Mycoth. Ven. no. 1287 !, on leaves of *Bambusa arundinacea*.

The examination of a long series of these specimens leads (as it often does in similar cases) to the conclusion that the only logical course is to class them all as one species, with subdivisions which may be called subspecies, varieties or forms, according to taste. The occurrence of series of this kind is well-known to the working mycologist. The extreme forms may easily be considered as distinctly marked off from one another, if the intermediate forms have been unseen or ignored. As examples one may cite *Lepiota procera* and *L. rachodes*, *Boletus chrysenteron* and *B. subtomentosus*, *Poria vaporaria* and *Irpex obliquus*, *Dasyscypha nivea* and *D. virginea*. In all these cases only those who determinedly shut their eyes or vouchsafe only a cursory examination can maintain the old distinctions, which arose from insufficient breadth of knowledge. It is not a case of "lumping" v. "splitting," as in the days of the old belief in the rigidity of species. There is a third course, and as usual the golden mean is the best. The immediate adoption of such a method (which must inevitably be adopted by future generations, to save their reason !) would effect a much needed economy in the time and trouble of present day mycologists, not to speak of other naturalists. But it must be done from nature, not from books : that way chaos lies.

The appropriate classification of the forms of *Melanconium sphaerospermum* that have been found in Britain will then be :—

Sub-species 1. *Arundinis*, spores circular, 8-~~10~~ 9 μ in diameter.

,, ,, 2. *inquinans*, spores ovoid or irregular, 6-8 μ in diameter.

,, ,, 3. *Bambusae*, spores as in 2, pustules small, less elongated.

On culms and leaves of *Phragmites communis*, *Arundo Donax*, *Bambusa*, *Arundinaria*, *Andropogon*, *Pennisetum* and similar grasses, in Europe, North and South Africa, India, Japan, Java, West Australia, and Tropical and Sub-tropical America.

It is not necessary to distinguish the forms, as Saccardo did, into erumpent and superficial; that depends almost entirely upon the age and state of preservation of the specimens; they are all similar when fresh, except perhaps those upon the leaves. It

is not necessary to distinguish the spores as flat or subglobose; they are all compressed in a similar way, although this character can be easily overlooked. Roumeguère and others have repeatedly described the spores falsely as spherical; Corda figured them nearly as they are. To ascertain this, nothing is easier than to adopt the device used by those who investigate Diatoms and Desmids, viz., by pressure upon the cover glass to cause the spores to roll over and over (in a sufficient depth of water). Then one sees a single mature spore exhibit all the phases that might be supposed to be shown by a very oblate Saturn, if the planet could be treated in such a disrespectful way.

It would be idle to speculate as to the cause that determines which of the three sub-specific forms the fungus shall assume: it may be the age, size, or vigour of the host, it may be the favourableness or unfavourableness of the season at the time of growth. Experiment alone can settle this question: only one thing is certain, it is not the species or genus of the host alone. There is, however, strong reason for believing that, when the subspecies *Bambusae* is found in this country, as it often is, on bamboo sticks in gardens, it was imported in an undeveloped state on the canes, and merely became effused when they were left in the damp ground here.

Besides the forms mentioned above, there are two others closely allied, but possibly distinct, not yet found in Britain.

One is *Coniosporium rhizophilum*, Sacc. Mich. ii. 124 = *Gymnosporium rhizophilum*, Preuss, in Linnaea, 1851, xxiv. 102, which is recorded on dead rhizomes of *Triticum repens*, *Agrostis* and *Cynodon* on the Continent, and should also occur in this country. It does not seem to differ from *M. sphaerospermum* sub-sp. 2, but in the absence of good specimens that point cannot be decided. The only exsiccatum seen, and that a very poor one, is *C. rhizophilum*, Sydow, Mycoth. Germ. no. 149!, on ploughed up rhizomes of *Triticum repens*. This has the spores of *inquinans*: some other exsiccata under the same name were chiefly *Epicoccum*.

The other is *Coniosporium circumscissum*, Sacc. Syll. iv. 244 = *Gymnosporium circumscissum*, B. et Br. Fung. Ceyl. no. 811. This also has the spores of *inquinans*, but differs in the shape of the pustules. It is, however, certainly congeneric with the others, and may be described as:—

Melanconium circumscissum, *Grove*. Pustules oblong, 0·5-1 mm. long, smaller and more compact than in *M. sphaerospermum* sub-sp. *Arundinis*, and differing from that in splitting in a circumscissile manner. Spores 6-7 × 2-2·5 μ, shaped exactly as in *M. sphaerospermum* sub-sp. *inquinans*.

On culms of bamboo, Peradeniya, Herb. Berk. no. 1050!; on dead bamboo canes, Philippine Islands, Herb. Govt. Labor. no. 37!

In this sub-species the epidermis over the pustules splits not only in two parallel lines, placed longitudinally on the cane, (as often occurs in *M. sphaerospermum* sub-sp. *Arundinis*), but also splits across transversely at each end, thus completing the

severance of a portion of it, which then falls off as a lid, much after the style of *Stegia Ilicis*, but oblong not round in shape. In the Ceylon specimen the "lids" are still present; in the more advanced one from the Philippines they have all disappeared and the fungus looks quite superficial. Occasionally similar states can be seen in examining specimens of *M. spherospermum* sub-sp. 3, on bamboo canes. In fact, no. 5 forms a link between nos. 2 and 3. Therefore both the above-mentioned might conveniently be classed under the same head, and a truer representation of the facts would probably be:—

Sub-species 1. *Arundinis.*
,, 2. *inquinans.*
,, 3. *Bambusae.*
,, 4. *rhizophilum.*
,, 5. *circumscissum*

In addition to all these, there are others which present greater differences. One group is distinguished by its much larger spores. To this belongs *Melanconium arundinaceum*, Ell. et Ev. in Bull. Torr. Bot. Club, 1897, xxiv. 290, which is described as follows:—

"Pustules gregarious, elliptical, about 1·5 × 1 mm., lens-shaped, covered by the lead-coloured epidermis which finally splits along the middle. Spores globose, 15-20 μ diam., or ellipsoid, 18-22 × 13-16 μ; sporophores shorter."

"On dead canes of *Arundinaria*, Louisiana."

It will be noted that nothing is said about compression of the spores, a point which certain observers have persistently overlooked: in the absence of specimens, however, this point cannot be settled. But there is another described species, *M. saccharinum* Penz. et Sacc. in Malpighia, 1901, p. 238, on dead or dying leaves of *Saccharum officinarum* in Java, which is stated to be very similar to *M. arundinaceum*, but having the spores globose-compressed, 24 μ wide, 14 μ thick; this suggests unmistakably that the spores of *M. arundinaceum* are also compressed, and that *M. saccharinum* is its leaf form, and possibly parasitic.

Several other species on bamboo have been described, differing in certain details, but of these also no specimens are available, viz.:—

M. (?) *bambusinum*, Speg. (Sacc. Syll. x. 474).
M. hysterinum, Sacc. (,, ,, xi. 572).
M. Shiraianum, Syd. (,, ,, xvi. 1009).

The latter, which is apparently = *Coniosporium hysterinum*, Bubák (Sacc. Syll. xviii. 564), is hardly different from *M. sphaerospermum* sub-sp. *Bambusae*; nor the two former from *M. arundinaceum*. One cannot but believe that all these confused species, impinging upon one another at so many points, could be reduced to a much smaller number by critical examination of the actual specimens, but without these it is only possible to call

attention to the probabilities of the case. The habit of giving cursory and incomplete descriptions of "new species" of fungi (unaccompanied by figures) has survived from the time of Persoon and Link, and is to blame for an extensive waste of space in many mycological publications.

So far there has been hardly a single indication that these forms are other than saprophytic. But quite recently Turconi has published a paper "On a New Malady of Bamboo" (Sopra una nuova malattia dei bambù) in Atti Real. Accad. Lincei, Rendic. 1916, xxv. p. 528. This account is amplified in Atti Istit. Bot. Pavia, 1916, xvi, p. 245, pl. 18. In these Turconi states that, in the summer of 1914, a grave disease affected a plantation of *Bambusa mitis* at Pavia. On the diseased culms there were found two fungi which he names *Melanconium Bambusae* sp.n. and *Scirrhia Bambusae*, sp.n.; he considers the former to be a conidial stage of the latter, and he proved by experiment that the disease could be transferred, not only to healthy *B. mitis*, but also to *B. gracilis* and *B. nigra*. The infection was made both by the natural spores, and by the mycelium obtained by cultures from the spores. Attempts to infect *B. arundinacea* gave negative results. The description of the *Melanconium* stage shows that it is practically identical with *M. saccharinum*, Penz. et Sacc., mentioned above, but if so Turconi, like many other mycologists in similar cases, failed to notice that the spores were compressed.

EXCLUDED SPECIES.

Melanconium Rusci, Cooke et Mass. in Grevill. xvii. 3. Sacc. Syll. x. 473.

"Pustules scattered, orbicular, erumpent, covered by the lacerated brown cuticle. Conidia elliptical, continuous, sooty-olive, $12 \times 7\text{-}8$ μ.

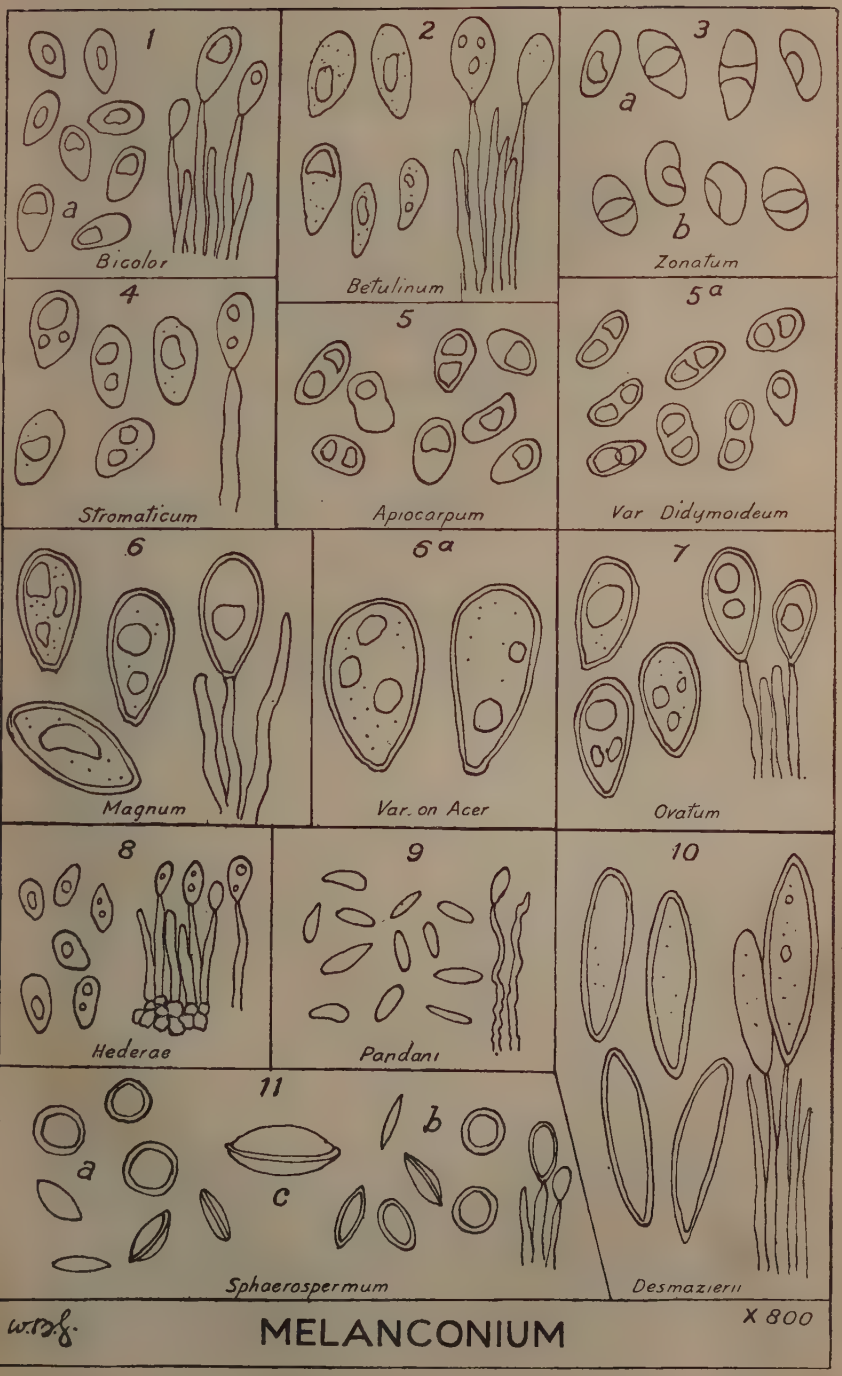
"On phyllodes" [sic] "of *Ruscus aculeatus*, Kew. This cannot be a form of *Sphaeropsis Rusci*, for there is no perithecium and the pustules are scattered and solitary" (C. & M.)

An indubitable error: whatever the specimens may have been, they are not a *Melanconium*, and apparently not a fungus at all.

Explanation of Figures.

1. *Melanconium bicolor*, on Birch; *a*, two spores of *D. profusum* (Grev.).
2. *M. betulinum*, on Birch.
3. *M. zonatum*; *a*, from J. B. Ellis's specimen on *Ostrya*.
   b, from Berkeley's specimen, no. 1574.
4. *M. stromaticum*, on Hornbeam.
5. *M. apiocarpum*, on Alder.

5*a*. ,, , var. *didymoideum*, from J. W. Ellis's Bridgnorth specimen.


1
a
Bicolor
2
Betulinum
3
a
b
Zonatum
4
Stromaticum
5
Apiocarpum
5a
Var Didymoideum
6
Magnum
6a
Var. on Acer
7
Ovatum
8
Hederae
9
Pandani
10
Desmazierii
11
a
b
c
Sphaerospermum
W.R.S.
MELANCONIUM
X 800

6. *M. magnum*, on Walnut.

6*a*. ,, , var. on *Acer*, U.S.A.

7. *M. ovatum*, on Beech, from the Batheaston specimen.

8. *M. Hederae*, on Ivy.

9. *M. Pandani*, on Screw Pine.

10. *M. Desmazierii*, on Lime.

11. *M. sphaerospermum*; *a*, on *Phragmites*.
b, on Bamboo cane.
c, diagrammatic view of a typical spore.

All the figures, except 11*c*, × 800 times.

XV.—NOTES ON AFRICAN COMPOSITAE: V.

J. Hutchinson.

Hippia, *Linn.*

The genus *Hippia* is distinguished from other South African members of the tribe *Anthemideae* by its alternate mostly divided or toothed leaves, epaleaceous receptacle, discoid heterogamous flower-heads, with the marginal flowers female and very much reduced, and the male flowers well developed but sterile, with 5-lobed corollas. There is no indication of a pappus in any of the species, but the flat achenes when dry have a submembranous border which is no doubt an adaptation for wind dispersal. One or two resemble certain species of *Cotula*, which genus differs in having 4-lobed male corollas with flattened or winged tubes. Observations on the pollination of the flowers would no doubt prove interesting, for in many of the female flowers examined the minute reduced corollas appear as if they had slightly increased in size after fertilisation, at the same time perhaps becoming somewhat mucilaginous and entirely covering the styles. The fertile achenes appear to be nearly mature by the time the male flowers in the same head begin to open.

Hippia is confined to South Africa and occupies a rather restricted area of the South Western Region from the Cape and Tulbagh Divisions in the west to Humansdorp in the east. The larger species, especially *H. frutescens*, bear considerable resemblance to the boreal *Tanacetum*, of which the genus might be regarded as an extreme reduction. Indeed, the reduction in *Hippia* has gone about as far as can be supposed possible in the *Compositae*. This is shown clearly by the few bracts, epaleaceous receptacle, bisexual flowers, the males abortive, the extremely reduced female corollas and the dorsally flattened epappose achenes.

CLAVIS SPECIERUM.

Folia integra vel plerumque bi-vel tridentata, sessilia... ... ... 1. *integrifolia.*
Folia profunde trilobata, imbricata ... ... 2. *trilobata.*
Folia pinnatilobata vel pinnatisecta, rarius etiam trilobata:—
Foliorum segmenta utrinsecus 1–2, lamina basin versus in petiolum angustissimum attenuata; achaenia dense pilosa ... ... 3. *Bolusae.*
Foliorum segmenta utrinsecus 3–8, lamina sessilia vel leviter petiolata:—
Foliorum segmenta triangularia vel ovato-triangularia; achaenia glabra ... ... 4. *hirsuta.*
Foliorum segmenta linearia vel oblanceolata:—
Rami graciles, plerumque decumbentes vel subascendentes; folia usque ad 2 cm. longa, pilosa; achaenia scabrido-papillosa ... . 5. *pilosa.*
Rami satis robusti, erecti; folia brevissime pubescentia, 2–4·5 cm. longa; achaenia glabra ... ... 6. *frutescens.*

Leaves and floral details of *Hippia*; the numbers correspond with those of the species in the text.

1. **H. integrifolia**, *Less.* Synop. Composit. 268 (1832); DC. Prodr. vi. 144; Harv. in Harv. et Sond. Fl. Cap. iii. 171.

Descr. ampl.—*Caules* diffusi, elongati, dense foliati, villoso-pilosi. *Folia* sessilia, reflexa, obvato-oblanceolata, bi-vel tri-

dentata vel rarius integra, 1-1·5 cm. longa, 3-8 mm. lata, dense hirsuta, glandulis aurantiacis sessilibus ornata, demum minute foveolata. *Capitula* pauca, in cymas breves disposita, breviter pedunculata, pauciflora. *Involucri bracteae* 3-seriatae, exteriores 3-4, oblongo-ovatae, subacutae, 2·5 mm. longae, 1·75 mm. latae, 1-nerviae, longe ciliatae, intermediae obvatae, 3·5 mm. longae, dorso pilosae, margine pectinato-ciliatae, interiores circiter 5, spathulatae, dentatae, ciliatae, 3 mm. longae. *Corollae tubus* 1·5 mm. longus, a basi cylindrico late expansus, extra glandibus sessilibus ornatus, lobi lancealato-ovati, subacuti, 0·75 mm. lati. *Antherae* 0·75 mm. longae. *Achaenia* matura non visa.

South Africa.—South Western Region: Swellendam; Mt. Peak near Swellendam, Jan., *Burchell* 7297; "Cape," Vahl; *Ecklon & Zeyher.*

As there is no authentic example of this species at Kew, I have described Burchell's plant in more detail than may be found in Lessing's original. The identity of *Burchell* 7297 with Lessing's *H. integrifolia* has been very kindly confirmed by Prof. Dixon, of Dublin, where a type specimen is preserved. According to Harvey there are also specimens in the Sonder and Cape Herbaria.

2. **Hippia trilobata,** *Hutchinson,* sp. nov.

Caules diffusi, graciles, dense foliati, minute puberuli. *Folia* sessilia, reflexa, ad medium trilobata, basi cuneata, 5-7 mm. longa, 3-7 mm. lata, tenuiter chartacea, infra longe pilosa et nigro-punctata. *Capitula* terminalia, solitaria, sessilia, foliis superioribus circumdata. *Involucri bracteae* subfoliaceae, ovatae, 2·5-3 mm. longae, villosae. *Flores* desunt.

South Africa.—South Western Region: Riversdale; Kampsche Berg, shady sides towards the summit, Dec. 1814, *Burchell* 7092.

I have not been able to find any flowers on Burchell's otherwise very good specimen. The affinity is so clear with *H. integrifolia,* Less., that in spite of their absence I have thought it worth while describing.

3. **H. Bolusae**, *Hutchinson* in Ann. S. Afr. Mus. ix. pt. vi. 394, fig. 7.

South Africa.—Karroo Region: Ceres; fissures of rocks at Mitchell's Pass, about 600 m., Oct., *Bolus* 2612*; *Pearson* 3534. Worcester; mountains above Worcester, *Rehmann* 2662.

A very neat and beautiful little plant which reminds one very much of the tiny leaved *Helxine Solcirolii,* Req., so familiar now as an edging to stages in English greenhouses. This species might very well be suitable for the same purpose.

4. **H. hirsuta**, *DC.* Prodr. vi. 144 (1837); Harv. in Harv. et Sond. Fl. Cap. iii. 171.

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* Erroneously cited in Ann. S. Afr. Mus. l.c. as no. 2616.

South Africa.—South Western Region: Riversdale; in moist places about the waterfall at Garcias Pass, Dec., *Burchell* 6981 (type).

5. **Hippia pilosa**, *Hutchinson*, comb. nov.

Tanacetum pilosum, Berg. Cap. 244 (1767). *T. cotuloides*, Linn. Mant. 282 (1771). *Cotula fimbriata*, Spreng. Neue Entdeck. iii. 41 (1822). *Hippia gracilis*, Less. Synop. Comp. 268 (1832); Harv. in Harv. et Sond. Fl. Cap. iii. 170, incl. var. *repens*, Harv. l.c. 171; Bolus et Wolley-Dod in Trans. S. Afr. Phil. Soc. xiv. 283. *H. repens*, DC. Prodr. vi. 144 (1837). *H. cotuliodes*, O. Kuntze, Rev. Gen. Pl. iii. ii. 159 (1893). *Tanacetum laciniatum, foliis super. trifidis*, etc., Vaill. Act. Paris, 1719, 337.

South Africa.—South Western Region: Cape; Table Mt., Nov. *Ecklon* 787; top of Skeleton Ravine, Aug., *Wolley-Dod* 2947; south slopes of Klaasjagersberg, Aug., *Wolley-Dod* 1502; lower slopes of Table Mt., among rocks, 700 m., Sept., *Bolus* 3938; Newlands, Sept., *Wilms* 3378; Simons Bay, *Wright;* damp places on Table Mt., *Milne* 74; *MacGillivray* 525; *MacOwan* 122. Worcester; Dutoits Kloof, 2000 m., Oct.-Jan., *Drège a.* Caledon; Zwart Berg, near the Hot Springs, 300-650 m., Aug., *Zeyher* 2837; *Pappe;* Genadendal, 1000-1300 m., *Drège a.* Swellendam; mountain peak near Swellendam, Jan., *Burchell* 7305. Riversdale: Garcias Pass, bushy shrub on mountain slopes, Sept., 1908, *Phillips* 359. Oudtshoorn; Zwartberg Pass, 1700 m., Dec., *Bolus* 12020.

6. **H. frutescens,** *Linn.* Mant. 291 (1771); Thunb. Fl. Cap. ed. Schult. 723; DC. Prodr. vi. 144; Harv. in Harv. et Sond. Fl. Cap. iii. 170. *Tanacetum frutescens*, Linn. Sp. Pl. 1183 (1763).

South Africa.—South Western Region: Tulbagh; banks of streams below Winterhoek, Sept., *Thunberg*; Saron, 800 m., Oct., *Schlechter* 10686, 10689. Paarl; Paarl Mt., damp places 1000-2000 ft., Aug.-Oct., *Drège a*; Paarl Klip, Oct., *Bolus* 3169. Swellendam; *Zeyher*. George; near Lange Valley, Aug., *Burchell* 5700; near George, *Burchell* 6039. Knysna, between Knysna and the mouth of the Knysna River, July, *Burchell* 5513; Ruigte Valley, below 160 m., Sept., *Drège b*; Plettenbergs Bay, Mar., *Mund* 81. Humansdorp; north side of Kromme River, near Wagenboom Station, Mar., *Burchell* 4869. "Cape," *Thom* 4; 986. Cultivated in France in 1821 (Herb. Gay).

XVI.—WOOD PRESERVATION.

W. Dallimore.

The application of various chemicals of a preservative character to wood has for many years played an important part in timber economy, and users of large quantities of wood are keenly alive to the necessity of availing themselves of every possible means of prolonging its period of usefulness.

Preservatives are applied to timber for one or more of several objects, i.e., to render it less susceptible to attacks from parasitic fungi; to make it as far as possible waterproof; to preserve it and at the same time improve its appearance; to prevent or check the ravages of boring insects and other forms of animal life and to render it less inflammable.

In some instances one application may suffice for two or more of these objects, for chemicals are available that are poisonous alike to fungi and insects, or which possess both antiseptic and water-proofing properties.

The chief danger to unprotected wood in temperate countries must be anticipated from parasitic fungi for mycelium of certain species may be present in the timber when it is felled or purchased; whether or not, there are always spores floating about in the atmosphere which are a source of danger to wood upon which they may fall. For some time the presence of spores or mycelium may pass unnoticed, but directly conditions arise which favour development, growth becomes active and signs of decay or breaking up of the wood tissues are soon seen. If, however, the conditions are unfavourable to fungus growth, the spores and mycelium will probably remain dormant or die. For this reason timber that is to be utilised for positions favourable to fungus growth should be rendered as far as possible proof against fungus attacks by the application of an agent which is poisonous to such lowly forms of plant life.

Soft woods in contact with the ground are very liable to attacks by fungi and they soon decay if not protected in some way. Railway sleepers of yellow deal, laid in their natural state, would often be useless at the end of a year or two, but treated with a preservative they remain sound for 12 or 15 years or even longer. Telegraph and telephone poles as brought from the forest would decay in a very short time, but after the removal of the bark and treatment with a preservative they will last for many years. Paving blocks of Scots pine would not be worth laying as cut from the log, but when treated with an antiseptic, laid on a proper foundation and coated with a waterproof covering, they frequently wear well for a dozen years or more even where traffic is heavy. Thinnings from young plantations have often little value in a natural state owing to the large proportion of sap wood which is peculiarly liable to decay, but after proper immersion in creosote, they can be profitably utilised for fencing and other purposes. Sheds and farm buildings constructed of preserved timber are yearly becoming more popular, but it appears that a good deal more preserved timber might be used for such work.

Fence timber deserves special attention and no post ought to be placed in the ground that has not had at least the lower part treated with an antiseptic. The weakest part of a post is that about the ground line or, roughly, the portion occurring 9 in. above and 9 in. below the ground level, a point often described as "between wind and water." This section is constantly exposed to moisture from the soil and to the drying effects of the air but can never become as dry as the more exposed parts,

neither is it in such an equable state of moisture as the deeply buried portion from which air is excluded. Decay usually begins about, or just below, the surface of the soil and quickly spreads for a few inches upwards and downwards. This condition is often very noticeable in suburban districts where gardens are separated by wood fences. Unprotected deal posts are used for cheapness, the exposed parts being coloured by a thin tar oil, and the buried parts left in the natural state. After a couple of years or so the posts rot and break off at the ground line. Some hardwoods such as oak, false acacia (*Robinia*), and elm, stand well for a number of years, but as a rule well-preserved soft woods outlast unpreserved hard woods, therefore the most susceptible parts of posts should be rendered poisonous to wood-destroying fungi even if the whole cannot be treated.

Before, however, subjecting woodwork to preservative treatment it should, in most cases, be properly worked and be quite ready for fitting into place both for effectiveness and economy, for it must be remembered that the antiseptic solution cannot be depended upon to soak thoroughly into the centre of thick sections and any untreated wood exposed by subsequent working may be attacked by fungus; at the same time it is only profitable to preserve such wood as will eventually be utilised.

Preservation of wood against fungus attacks may be effected by means of oily or watery solutions. The oily substances are usually heavy tar oils or sometimes petroleum, or those oils may be mixed with another substance. The commonest and most popular antiseptic in this country, apart from ordinary paints, is dead oil of tar, commonly, but erroneously, called creosote, which may be applied cold but is more often injected in a heated condition under considerable pressure. The watery solutions usually contain certain salts such as zinc-chloride, bi-chloride of mercury, copper sulphate, &c., but sugar and various other substances may be dissolved in water and injected into timber. Several proprietary mixtures can also be procured for the purpose.

When the treated wood is to be exposed to moisture a certain amount of water-proofing is desirable, and with that in view the oils and the proprietary mixtures with oil as a base, are preferable to watery solutions, for the salts may leach out through excessive damp.

In most cases seasoned wood is more amenable to treatment than unseasoned, although in one or two instances, the copper sulphate method of preserving in particular, the chemical must be introduced as soon after the trees are felled as possible and before the removal of the bark. This is one instance in which it is not possible to work the wood before impregnation.

To preserve wood against the attacks of insects and marine borers it is necessary to make it poisonous to animal life or to render it objectionable in some other way. Highly scented woods as a rule are less subject to injury by insects than those that are inodorous and in some instances good results have followed after dressing unscented wood with cedar oil. The majority of the substances used to safeguard wood from fungus attack also render it poisonous to insects, whilst piles and wharf timbers thoroughly

impregnated with heavy tar oils are better able to withstand the attacks of marine borers than timber prepared in any other way. The progress of decay in furniture and other woodwork brought about by the presence of the larvae of beetles or other insects may be checked or stopped by killing the larvae in the wood. This can be done by heating the timber or by soaking it in a solution of carbolic acid or corrosive sublimate. It is also possible to kill larvae by placing the infested wood in a closed room or retort and exposing it to the fumes of bi-sulphide of carbon. Considerable good can also be done by applying the liquid with a painter's brush, taking care to fill all the holes. It must, however, be remembered that the substance is highly inflammable. Carbon tetrachloride mixed with a little cedar oil or naphthalene may also be applied to insect-infested wood with good results. It should be noted that any of these substances applied to polished wood destroy the polish. Bamboos used in a natural state in some tropical countries are soon ruined by beetles, but in India, after being thoroughly soaked in water, they are found to be resistant to their attack. The reason is not clear, but it may be that the water makes the stems distasteful or that larvae may be present in small numbers in the green stems which multiply very rapidly as they dry, whereas, by first soaking the bamboos in water the larvae are drowned.

Many substances have been employed for the purpose of rendering wood less inflammable, borax and salts of ammonia being amongst the most satisfactory.

It is not the intention in this article to describe fully the various means employed for preserving wood from any of the destructive agencies referred to but to pass in review some of the more important contributions to the subject from which full details can be gleaned by anyone interested in the work.

The most important work recently published in this country is a book entitled "The Preservation of Wood," by Mr. A. J. Wallis-Tayler.* It is really an elaboration of a lecture given by the author before the Royal Society of Arts, early in 1914, which was printed in the Society's Journal for Feb. 20th of that year. The book commences with a chapter on the history of wood preservation, followed by a chapter on the destruction of wood by decay and the ravages of insects, marine worms, &c. There is then a chapter on seasoning and drying with various tables and diagrams showing moisture contents, &c., of different kinds of woods. Natural air seasoning, seasoning by steam, water seasoning, artificial seasoning or drying by heat (hot air), drying or seasoning by natural air circulation, drying or seasoning by oxygen, drying or seasoning by smoke, drying or seasoning by scorching or charring, drying or seasoning by electricity, effect of time on the strength of wood and the effect of moisture on the strength of wood are the sub-headings of this chapter.

The preservative treatment of wood occupies chapters iv.-ix. Chapter iv. deals largely with the structure of wood, conditions essential to success, and the absorptive properties of various woods.

* Published by William Rider & Son, Limited, Paternoster Row, London E.C.; 344 pp., with more than 100 illustrations and numerous tables.

Chapter v. deals principally with the open tank system of preservation, the various methods being described with illustrations of the apparatus required. The more elaborate pressure system of impregnation is described in chapter vi., full particulars being given of the various processes adopted with green and seasoned wood, temperatures, pressure, descriptions of retorts and appliances with numerous illustrations of plant and capacity tables.

The principal processes with dead oil of tar, commonly called creosote, or with dead oil of tar as a base, are described in chapter vii. These are:—The Dead Oil of Tar, Bethel, or Creosoting Process. The Rueping Process. The Lowry Process. The Curtis-Isaacs Process. Processes wherein creosote is used in conjunction with some other agent are:—The Zinc-creosote, Rutger or Card Process. The Allardyce Process. The Creo-resinate Process.

Chapter viii. deals with preservation by means of various salts and other substances, the preservative agents and processes being as follows:—The Bichloride of Mercury Process or "Kyanizing." The Zinc-chloride Process or "Burnettizing." "Burnettizine." The Zinc-tannin or Wellhouse Process. The Boucherie Process. The Hasselmann Process. The Vulcanizing or Haskinizing Process. The Saccharine Solution or "Powellizing" Process. The Guissani Process. The Cresol-calcium Process. The Aczol Process. The Naphthalene Process. The use of Natural Oils as Preservative Agents.

This is followed by a chapter on various proprietary and other preservative solutions, the subjects described being:—Anthrol, Atlas, Bellit, Carbolineum, Dyphenin, Green Oil, Hylinit, Jodelite, Microlineum, Microsol, Sideroleum, Solignum, Sotor, Stoprot, Wilcoo, &c.

An account of the absorption limit and life of preserved wood is given in chapter x. The fire-proofing and fire-retardent treatment of wood is the subject of chapter xi. The cost of the various methods of treatment is discussed in chapter xii. and that is followed by an appendix of 38 pages given to formulae, tables, and memoranda on various subjects connected with the preservation of wood, the book being ended by a good index of 14 pages.

Although less comprehensive than the foregoing work the following are exceedingly useful as being in most instances the results of special studies upon definite branches of wood preservation:—"Treated Wood-block Paving," by W. G. Mitchell, M.Sc., Bulletin 49, Forestry Branch, Department of the Interior, Canada, pp. 1-40, illustrated. In this bulletin the author deals very fully with the impregnation of street paving blocks and with laying wood pavement, comparing the methods in various countries. A bibliography of works upon wood pavement, creosote oils and impregnation is also given.

"A Visual Method for Determining the Penetration of Inorganic Salts in Treated Wood," by E. Bateman, pp. 1-5, Forest Service Circular, 190, U.S. Department of Agriculture. In order to show the depth of penetration by an inorganic salt such as zinc chloride, solutions of potassium ferrocyanide and uranium

acetate are applied to newly-cut surfaces of wood and the penetration line is shown by the colour reaction.

"Volatilization of Various Fractions of Creosote after their Injection into Wood," by C. H. Teesdale, pp. 1-5, Forest Service Circular 188, U.S. Dept. of Agric.

"The Absorption of Creosote by the Cell Walls of Wood," by C. H. Teesdale, pp. 1-7, Forest Service Circular 200, U.S. Dept. of Agric. A record of certain tests carried out at the Forest Products Labratories.

"Commercial Creosotes with Special Reference to Protection of Wood from Decay," by Carlile P. Winslow, pp. 1-38, Forest Service Circular, 206, U.S. Dept. of Agric. A considerable amount of information upon the various grades of commercial creosotes is presented in this paper, their different constituents being represented by diagrams and tables.

"The Preservative Treatment of Loblolly Pine Cross-arms," by W. F. Sherfesee, pp. 1-29, Forest Service Circular 151, U.S. Dept. of Agric. This is a record of experiments in grading, seasoning and creosoting certain classes of wood. The experiments were conducted with 14,000 cross-arms fresh from the forest, the object being to devise a plan or process which would insure a uniform, efficient and cheap impregnation. Before treatment the arms were graded into three groups according to the quantity of sap and heart wood present. The processes of seasoning and impregnation adopted are given in detail. It was found that air-dry sap wood could be thoroughly saturated with warm creosote at about 125° F. to 140° F., without pressure, but that to saturate heart wood, pressure was necessary. It was also found that the creosote was afterwards more easily withdrawn from the cells of sap wood than from heart wood. The results indicate that sap wood should be allowed to retain 10 lbs. of oil per cubic foot, whereas in heart wood 6 lbs. will suffice. Perfectly green timber subjected to the same process as dry sap wood took up 2·2 lbs. per cubic foot during the time that dry sap wood took up 12·6 lbs. per cubic foot. The results of the experiments indicate how a considerable saving of oil can be made.

"Experiments on the Strength of Treated Timber," by W. Kendrick Hatt, Ph.D., pp. 1-31, Forest Service Circular 39, U.S. Dept. of Agric. The physical characteristics and strength of timber treated with zinc-chloride and creosote are discussed in this circular. The conclusions arrived at appear to be—1. That a high degree of steam is injurious, the limit of safety for loblolly pine being 30 lbs. for 4 hours or 20 lbs. for 6 hours. 2. The presence of zinc-chloride will not weaken wood under static loading, although the indications are that the wood becomes brittle under impact. 3. The presence of creosote will not weaken wood of itself. Since apparently it is present only in the openings of the cells, and does not get into the cell walls, its action can only be to retard the seasoning of the wood. Various tables are given showing methods employed in the treatment of the wood with the results.

"Experiments with Railway Cross-ties," by H. B. Eastman, pp. 1-21, Forest Service Circular 146, U.S. Dept. of Agric. The

experiments undertaken in this case were to determine. 1. The green weight and rate of seasoning of timbers cut in different months. 2. The absorptive power of seasoned timber cut in different months. 3. The comparative durability of green, seasoned, and treated timbers when laid under similar conditions with different kinds of tie plates and rail-fastenings in a test track. The woods under experiment were *Pseudotsuga Douglasii* (Douglas Fir), *Larix occidentalis* (Western Larch), *Tsuga Albertiana* (Western Hemlock), and *Thuya plicata* (Canoe Cedar).

"The Estimation of Moisture in Creosoted Wood," by Arthur L. Dean, pp. 1-7, Forest Service Circular 134, U.S. Dept. of Agric.

"The Seasoning and Preservative Treatment of Hemlock and Tamarack Cross-ties," by W. F. Sherfesee, pp. 1-31, Forest Service Circular 132, U.S. Dept. of Agric. This deals with seasoning of timber and impregnation with zinc-chloride under various conditions. The results of the investigations appear to indicate that unseasoned timber of these species should not be subjected to injection, that close-grained wood is not easily treated and that hemlock ties that weigh more than 40 lbs. per cubic foot and tamarack ties which weigh more than 42 lbs. per cubic foot should not be subjected to impregnation. It was also found that better results were obtained by treating the two woods separately than by mixing them in the same charge.

"Prolonging the Life of Mine Timbers," by John M. Nelson, pp. 1-22, Forest Service Circular 111, U.S. Dept. of Agric. Experiments were conducted with various kinds of mine timber under brush, open tank and pressure treatment. Oil of creosote, carbolineum, salt solution, and zinc chloride were used.

"Preservative Treatment of Poles," by William H. Kempfer, pp. 1-55, Forest Service Bulletin 84, U.S. Dept. of Agric. In this bulletin the results of different kinds of treatment of various woods used for telegraph and telephone poles are discussed. Numerous illustrations are given. See also Circular 103, Seasoning of Telephone and Telegraph Poles; Circular 104, Brush and Tank Pole Treatment; and Yearbook of the Department of Agriculture, U.S.A., Prolonging the Life of Telephone Poles.

"Cross-tie Forms and Rail Fastenings with Special Reference to Treated Timbers," by Hermann von Schrenk, pp. 1-70, Bulletin 50, Bureau of Forestry, U.S. Dept. of Agric. In this bulletin the advantages and disadvantages of various ways of sawing logs, seasoning, impregnation, and the laying of sleepers are dealt with. The work is well illustrated.

"The Open-tank Method for the Treatment of Timber," by Carl G. Crawford, pp. 1-15, Forest Service Circular 101, U.S. Dept. of Agric. This deals with the open air treatment of timber.

"Condition of Experimental Chestnut Poles in the Warren-Buffalo and Poughkeepsie-Newton Square Lines after Five and Eight Years' Service," by Carlile P. Winslow, pp. 1-13, Forest Service Circular 198, U.S. Dept. of Agric.

"Service Tests of Ties," by Howard F. Weiss, pp. 1-25, Forest Service Circular 209, U.S. Dept. of Agric. Particulars are given of sleepers of various kinds of woods impregnated with different preservatives.

"Report of the Use of Metal Railroad Ties and on Preservative Processes and Metal Tie Plates for Wooden Ties," by E. E. Russell Tratman, A.M., Am. Soc., C.E., pp. 1-363, Bulletin 9, Division of Forestry, U.S. Dept. of Agric. A great deal of information concerning wood preservatives and methods of treatment are given in this work.

"The Manual of Forestry," by Sir W. Schlich, and "The Forester," by James Brown and John Nisbet, both published in this country, also devote space to the principal methods of preserving timber.

"Creosoting of Sleepers," Indian Forester, July, 1914. A Report on creosoting Spruce, Silver Fir, Chil Pine, and Blue Pine, by Millars' Timber and Trading Company, Ltd.

"Note on the Antiseptic Treatment of Timber with special reference to Railway Sleepers," by R. S. Pearson, Imperial Forest Service, Indian Forest Records, vol. iii. pt. ii. 1912, pp. 1-107. This comprehensive work deals with the numerous methods of impregnating timber with antiseptics, paying special attention to Indian woods and particularly to those likely to be of value for sleepers. The various processes are described, and an idea is given of their relative value and cost. Solignum as a preventive of attacks by white ants is recommended, and on p. 82 the following remarks of the Imperial Entomologist at Puna, after experiments with the substance, are quoted:— "Solignum has given the best results of any white ant preservative on wood that I have yet tested, and was effective in stopping the entrance of white ants to a pucca building in which they were doing damage." Details of experiments, with the results, conducted with various kinds of timber exposed to the attacks of white ants are given. The article is of value to all who are interested in wood preservatives and particularly to those resident in the Tropics.

"Note on Ligno Protector as a possible means of Preventing Timber from Splitting while Seasoning," by R. S. Pearson, Forest Bulletin 13, 1913, pp. 1-12, Imperial Forest Service, India. The results of the experiments do not appear to have been conclusive.

"Preservative Treatment of Timber for Estate Purposes," by J. F. Annand, M.Sc., Quarterly Journal of Forestry, vol. viii., July, 1914, pp. 169-186. This paper deals with numerous experiments with saponified creosote and naphthalene by the open-tank method of impregnation.

"The Rueping Method of Creosoting," by W. P. Greenfield, Quarterly Journal of Forestry, vol. x., January, 1916, pp. 29-36. An article giving a good description of one of the special methods of impregnating timber with creosote.

"Increasing the Durability of Timber," by William Somerville, M.A., D.Sc., Journal of the Board of Agriculture,

vol. xviii. No. 4, July, 1911, pp. 281-287. Creosote is the principal substance dealt with in this article.

"A Note on the Preservation of Bamboos from the attacks of the Bamboo Beetle or Shot-Borer," by E. P. Stebbing, F.L.S., Forest Pamphlet 15, pp. 1-18, Imperial Forest Service, India, Various experiments are recorded and as a result it is recommended that bamboos be soaked for five days in water, and after drying that they be soaked for 48 hours in common Rangoon oil.

"Toxity of Various Wood Preservatives," by C. J. Humphrey and Ruth M. Fleming, report in the Journal of Industrial and Engineering Chemistry, vol. vi., 1914, p. 128. This article deals with the properties and killing point of various preservatives and is the result of investigations conducted in the Forest Labratory, Madison, Wisconsin. The subjects dealt with include:—Wood tar (hardwood), wood tar (Douglas fir), spiritine wood preserver, water gas tar creosote, coal tar creosote, avenarius carbolineum, S. P. F. carbolineum, C. A. wood preserver, Holzhelfer, No. 2097, copperized oil, fuel oil, kerosene, cresol-calcium, none-such special, sapwood antiseptic, sodium fluoride, zinc chloride, zinc sulphate. Another article on the same subject by E. P. Schoch, University of Texas, Austin, is to be found at p. 603 of the same volume.

"The Value of the Higher Phenols in Wood-preserving Oils," by Samuel Cabot, Journ. of Indust. and Engin. Chem., vol. iv., 1912, p. 206, and "Phenomenon of the Apparent Disappearance of the Higher Boiling Phenols in Creosoted Wood and its Explanation" by the same author in the same volume.

"Coal Tar Creosote Distillation and Individual Constituents: Comparative Toxity of Creosote for the Marine Wood Borer (*Xylotrya*)," by F. L. Schackell, American Wood Preservers' Association, Chicago, 1915.

The following three papers were read at a meeting of the Chemists' Club in New York, on November 25th, 1910, and appear in Journ. Soc. Chemical Industry, 1911, p. 190.

"The Actions of Oils and Tars in Preventing Mould Growth," by John Morris Weiss.

"Some Recent Publications on Creosote Oils," by S. R. Church.

"The Characteristics of Creosote and Tar Oils Available for Wood Preservation," by Charles N. Forrest.

"Impregnation of Wood with Brine in Russia," Journ. Soc. Chem. Indus., vol. xxix., p. 1311. It is said that in Russia, particularly in the south-east, brine is very largely used for impregnating railway sleepers and telegraph poles. Though not so efficient a preservative as creosote, brine is considerably cheaper. Special impregnating basins have been constructed in which the sleepers are placed in rows, and allowed to remain in the brine for 3 or 4 months. The brine contains 164 grms. of saline matter (136 grms. of sodium chloride) per litre. The brine does not penetrate far into the wood, the sleepers absorbing from 70 to 100 per cent. of their weight.

Attention ought also to be paid to the publications of the American Wood Preservers' Association, Baltimore.

XVII.—MISCELLANEOUS NOTES.

Maurice L. de Vilmorin.—French horticulture and especially French dendrology has sustained a severe loss in the death of Mr. M. L. de Vilmorin, which occurred at his country residence at Les Barres (Loiret), on April 21 last. In this country also and especially by Kew his loss will be greatly felt. He had for many years been in regular and cordial co-operation with this establishment, and it was to him more than to anyone that Kew was indebted for new Chinese plants in the days prior to the dispatch of collectors direct from this country to China. We may instance the *Davidia* which has lately made so fine a display in the Himalayan House at Kew. This, the first ever seen in England, was given to Kew by Mr. de Vilmorin. Many years ago he established relations with French missionaries in Central and Western China, especially with Delavay, David, Soulie and Farges. From them, stationed in what was at the time a practically unknown country so far as botany was concerned, he received a constant supply of seeds. The plants raised from them he distributed freely. His interests, however, were by no means confined to Chinese plants. At Les Barres, in 1894, he established a collection of shrubs scientifically arranged and probably the most comprehensive in Europe. In 1904 he published the "Fruticetum Vilmorinianum," a valuable list of the species grown at Les Barres, embellished with illustrations and notes.

Mr. de Vilmorin was the senior member of the famous firm of Vilmorin-Andrieux & Co. He fought in the Franco-Prussian war of 1870 and was a man of great culture and charming manners. To the representatives of Kew who visited Les Barres he always offered a warm welcome and kindly hospitality. His death, following so soon after that of his nephew Philippe de Vilmorin and Mr. Allard, of Angers, leaves the ranks of French dendrologists sadly depleted. He was 69 years of age, having been born on February 26, 1849, at Verrières-le-Buisson, the chief home of the de Vilmorin family.

Plantae Thunbergianae.—A few years ago Dr. Daydon Jackson rendered a great service to systematic botanists by preparing an Index to the Linnean Herbarium, which was issued as a supplement to the *Proceedings of the Linnean Society* in October, 1912. We now have the pleasure of welcoming an Index* to another famous herbarium, that of Linnaeus's distinguished pupil and successor in office, Carl Peter Thunberg, which has been compiled by Dr. H. O. Juel, the present Professor of Botany and Director of the Botanic Garden, University of Upsala. Professor Juel has kindly presented a copy of his work to Kew, to

* Plantae Thunbergianae. Ein Verzeichnis der von C. P. Thunberg in Südafrika, Indien und Japan gesammelten und der in seinen Schriften beschriebenen oder erwähnten Pflanzen, sowie von den Exemplaren derselben, die im Herbarium Thunbergianum in Upsala aufbewahrt sind; zusammengestellt von H. O. Juel. Arbeten utgifna med understöd af Vilhelm Exkmans Universitetsfond, Uppsala. Uppsala & Leipzig, 1918. 8vo. 462 pp., with portrait, sketch-map and 1 text illustration.

which he and his predecessors, from the time of Professor Elias M. Fries, have on many occasions afforded invaluable assistance by loaning to it portions of Thunberg's South African collections for use in the preparation of the *Flora Capensis*. The scope of the volume is indicated by the full title which is given on p. 190. The title-page is followed by a portrait of Thunberg, and the preface, which is in German, includes a biographical note, a sketch-map of his travels in South Africa, and a photograph of the memorial to Kaempfer and Thunberg, erected in Nagasaki by Ph. F. von Siebold. The usefulness of the work, which represents so much patience, industry and care, will be gratefully recognised and appreciated by many botanists and particularly by those who are interested in the floras of South Africa and Japan by the knowledge of which Thunberg has furnished us with some classical contributions.

Botanical Magazine.—The following plants are figured in the number for January, February and March:—*Paeonia peregrina*, Mill. (t. 8742), from the Balkan peninsula; *Pteridophyllum racemosum*, Sieb. & Zucc. (t. 8743), a native of the mountains of Central Japan; *Macodes Sanderiana*, Rolfe (t. 8744) from the Malay Archipelago; *Indigofera pendula*, Franch. (t. 8745), from Yunnan; *Agave fourcryodes*, Lem. (t. 8746), a native of Yucatan; *Rhododendron prostratum*, W. W. Smith (t. 8747), a native of the heights of the Likiang Range in Yunnan; *Echeveria setosa*, Rose & Purpus (t. 8748), from Southern Mexico; *Petunia integrifolia*, Hort. ex Harrison (*P. violacea*, Lindl.) (t. 8749) a native of Paraguay, Uraguay, S. Brazil and the Argentine; *Rhododendron brachyanthum*, Franch. (t. 8750), native of the Tali Range, Yunnan and *Asparagus falcatus*, Linn. (t. 8751) from Ceylon and also a native of Tropical and extra-Tropical South Africa.

In the number for April, May and June the following plants are figured:—*Primula anisodora*, Balf. f. et Forr. (t. 8752) from Yunnan; *Odontochilus lanceolatus*, Benth. (t. 8753) from Sikkim and Khasia; *Zanthoxylum planispinum*, Sieb. et Zucc. (t. 8754) from Japan; *Erlangea aggregata*, Hutchinson (t. 8755) a native of Angola; *Monadenium erubescens*, N. E. Brown (t. 8756) a native of Somaliland and Abyssinia; *Malus Sargentii*, Rehd. (t. 8757) from Japan; *Angraecum gracilipes*, Rolfe (t. 8758) a native of Madagascar; *Rhodendron siderophyllum*, Franch. (t. 8759) from Yunnan; *Howea Belmoreana*, Becc. (t. 8760) indigenous to Lord Howe's Island; *Bulbophyllum sociale*, Rolfe (t. 8761) a native of Sumatra; *Primula sylvicola*, Hort. ex Hutchinson (t. 8762) from Yunnan; and *Melicytus ramiflorus*, Forst. (t. 8763) from New Zealand and Polynesia.

A Rain Tree.—Dr. G. V. Perez, of Teneriffe, has sent us the following abridged translation of an article contributed by him to the Spanish paper "Real Sociedad Española de los Amigos del Árbol," No. 77, January, 1918, on how trees in a forest where mists usually form, precipitate water to a very remarkable extent.

The famous rain-tree in the Island of Ferro, Canaries, Dr. Perez writes, grew "on a headland where the mountain mists from the Trade winds collected, and by means of water tanks under it, the poor inhabitants of that island, where there are no springs, actually gathered enough water for drinking purposes. The tree was undoubtedly *Oreodaphne foetens*, Nees, because the old historians said it was like a laurel, but the fruit resembled the acorn of an oak."

The following is the abridged translation of the article:—

"How the mist collected over Table Mountain, south of Cape Town, is compared by travellers to a tablecloth; these clouds form more in the summer or rainless months when the S.E. winds blow harder.

"Dr. Marloth's experiments by means of two rain gauges, one representing the forest, are quoted, showing that from Dec. 1902 to Feb. 1903 nearly 80 in. (2 metres) of water was collected in the rain gauge representing the forest and very little in the other.

"Braine, in his book *Influence of Forests on Natural Water Supply*, obtained the particulars given above from the *Transactions of the South Africa Philosophical Society*, vols. 14 and 16.

"In the Canary Islands the Trade or N.E. winds bring about the formation of a similar belt of clouds between say 2000 and 5000 ft. altitude, where the evergreen forest of the Atlantic Islands grows best and amongst them a laurel called Til, which was undoubtedly the famous Garoe or Holy Tree of the Island of Ferro, which actually supplied that fountainless island with drinking water for the inhabitants until a storm blew it down.

"Anybody who has gone through a forest in the Canaries covered with mist can bear witness as to how much water is condensed by the foliage where trees grow.

"What creditable historians relate about the Holy Tree of Ferro is not a miracle but a scientific fact which has been proved at a similar altitude (Table Mountain) near Cape Town under similar circumstances and this fact should never be forgotten by those who sustain a campaign in favour of covering arid mountains by forests and thus utilizing the mountain mists in suitable localities."

VI.

ACTINONEMA ROSAE.

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